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ON COVERING GROUPS OF COMPACT SOLENOIDS

The questions considered in this report arose in the study of algebraic equations with coefficients in Banach algebras of generalized analytic functions. In this case one deals with solenoidal groups (see, e.g., [1]) and their coverings. Throughout $p : X \to G$ is an n-fold covering of a compact solenoidal group G by a connected topological space X. It turns out that there exists a morphism in the category of topological groups which is transformed by the forgetful functor between the categories of topological groups and spaces into p.

The problem on the existence of a group structure in a covering space of a topological group is also motivated by the well-known theorem on covering groups in algebraic topology [3,§51]. But we assume neither arcwise connectedness nor local connectedness of considering spaces.

Recall that, by the definition of a solenoidal group, there is a continuous homomorphism τ from the additive group of the real numbers R into G such that an one-parameter subgroup $\tau(R) = \{g_t \in G/t \in R\}$ is dense in G. So that, for any element $g \in G$, there exists a dense curve $\{gg_t/t \in R\}$ in G. Using the lifting path lemma, for each $x \in X$ we obtain a curve $\{T_t(x)/t \in R\}$ in X such that $pT_t(x) = p(x)g_t$ and $T_0(x) = x$. We also have a homeomorphism

$$T_t : X \to X : x \mapsto T_t(x)$$

for each $t \in R$.

To introduce the desired multiplication in X we need to study certain properties of the homeomorphisms T_t's. (For details we refer to [2]). In proving the theorem on covering groups the following lemmas play a crucial role.

Lemma 1. *Let g be an element of G and let $\{W_1, W_2, \ldots, W_m\}$ be a covering of G by evenly covered neighborhoods such that $g \in W_1 \setminus \bigcup_{k=2}^{m} W_k$. Let $p^{-1}(W_1) = \bigsqcup_{l=1}^{n} V_l$ and $p^{-1}(g) \cap V_1 = \{y_0\}$. Then there exists a neighborhood $V_0 \subset V_1$ of the point y_0 satisfying the following property: if $T_{t_0}(V_0) \cap V_0 \neq \emptyset$ for some $t_0 \in R$, then $T_{t_0}(V_0) \subset V_1$.*

Lemma 2. *An orbit $R_x = \{T_t(x) : t \in R\}$ of each point $x \in X$ is dense in the connected space X.*

Finally, we formulate the theorem on covering groups for compact solenoids.

Theorem. *Let $p : X \to G$ be an n-fold covering of compact solenoidal group G by a connected topological space X. Then there exists a group structure in X turning $p : X \to G$ into a homomorphism between compact abelian groups.*

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EXTREME PROPERTIES OF THE TAYLOR-SAFFMAN CURVE

Since the seminal Taylor-Saffman experiments and theoretical